

14/5/19 (E) 7

Exam. Code: 1015  
Sub. Code: 7760

1059

M.E. (Mechanical Engineering)-2<sup>nd</sup> Semester  
MME-201: Fluid Dynamics

Time allowed: 3 Hours

Max. Marks: 50

**NOTE:** Attempt five questions in all, selecting atleast two questions from each Unit.

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UNIT-I

- I. (a) Define with suitable examples and mathematical expressions; (i) steady flow, (ii) Unsteady flow, (iii) Uniform flow, (iv) Non-uniform flow.
- (b) If the lines of motion are curves on the surfaces of cones having their vertices at the origin and the axis of z for common surface, prove that the equation of continuity is:

$$\frac{\partial f}{\partial r} + \frac{\partial(fu)}{\partial r} + \frac{2fu}{r} + \frac{\operatorname{cosec}\theta}{r} \frac{\partial}{\partial \theta}(fw) = 0, \text{ where } v \text{ and } w \text{ are the velocity components in the directions in which } r \text{ and } \theta \text{ increase.} \quad (4+6)$$

- II. What is Euler's equation of motion? Derive it mathematically and how will you obtain Bernoulli's equation flow it? (10)

- III. (a) Write Navier-Stokes equation in Cartesian coordinates. Simplify the equation when (i) Fluid is incompressible and dynamic viscosity is constant, (ii) the fluid is incompressible and viscous effects are negligible.
- (b) Why do we use potential flow theory? How is it helpful in representing the real life problems where viscous forces dominate inside the boundary? (5+5)

- IV. (a) What is a boundary layer? Differentiate between a laminar and turbulent boundary layers.
- (b) Explain boundary layer separation with a neat sketch. What are the conditions under which separation takes place? (5+5)

UNIT-II

- V. (a) Find the stream function of the two-dimensional motion due to two equal sources and an equal sink situated midway between them.
- (b) State and prove Kelvin's minimum energy theorem. (5+5)

- VI. (a) A circular cylinder is placed in a uniform stream. Find the forces acting on the cylinder.
- (b) Differentiate between energy equation and momentum equation for compressible inviscid fluids. (6+4)

P.T.O.



(2)

- VII. (a) Write short notes on: -  
(i) Dynamic similarity,  
(ii) Inspection analysis  
(b) Discuss plane Poiseuille flow mathematically and obtain the velocity profile. (5+5)

VIII. Write a note on: -

- (a) Isentropic flow and stagnation properties.  
(b) Write short notes on: -  
(i) Prandtl number  
(ii) Nusselt number (6+4)

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